chronometer, and the exact level of the slide containing the sensitized plate is observed with an accurate clinometer before removing it from the camera.

As M. Janssen has pointed out, the chemical preparation and development of the plate require very great care, in order to obtain the requisite sharpness of detail. The gun-cotton for the collodion is prepared at a high temperature (70° C.), and numerous precautions are taken to ensure that the collodion film shall be perfectly even, and free from the smallest speck of foreign matter. The image is developed gradually, beginning with a solution of ferrous sulphate, and after thorough washing, completing with a solution of pyrogallic acid, after which the image is strengthened with a mixture of pyrogallic and silver nitrate solutions.

In a favourable state of the atmosphere, the pictures thus obtained leave nothing to be desired in point of sharpness and definition of detail. But, as a matter of course, all states of the atmosphere do not permit of equal success, the process being subject to the same atmospheric contingencies as in all astronomical work with the telescope. The best results were obtained in the late autumn, and during this last spring.

The character of the photospheric surface as displayed in the new photographs, will be best described in a translation of M. Janssen's own words: "The photographs show that the solar surface is covered everywhere with a fine granulation. The forms, dimensions, and arrangement of the granular elements are very varied. Their size varies from some tenths of a second to three or four seconds. The shapes are circular or elliptical, and more or less elongated; but often these regular forms are more or less distorted. The granulation is exhibited everywhere; and, at first sight, it does not appear to present a different constitution towards the polar regions. But this is a point to be further investigated. The illuminating power of the granular elements, taken separately, varies much; they appear to be situated at different depths in the photospheric layer. The most luminous of them, those which more especially contribute to the luminosity of the photosphere, occupy but a small fraction of the surface of the sun.

"But the most remarkable result yet obtained, and which is exclusively due to the employment of the photographic method, is the discovery of the photospheric network (*réseau photosphérique*). An attentive examination of the photographs shows that the photosphere has not an uniform structure throughout, but is divided into a series of figures, more or less distant from one another, and exhibiting a special constitution. These figures generally have rounded contours, but also often rectilinear and sometimes polygonal. Their dimensions are very variable, and they sometimes attain to a minute or more in diameter. While, in the intervals between these figures, the grains are distinct and definitely bounded, although of very variable size; in their interior, the granules are half obliterated, drawn out and confused; most frequently, indeed, they have disappeared, giving place to trains of matter which replace the granulations. Everything indicates that, in these spaces, the photospheric substance is subject to violent movements which have confounded the granular elements. . . . This fact enlightens us as to the forms taken by solar activity, and shows that this activity is always very great in the photosphere, even though there be no spot visible on the surface. I will further draw attention to this very important fact, of which very distinct evidence is furnished by certain photographs, viz., that numerous very dark points appear in the regularly granulated tracts, indicating that the photospheric layer can have but a very small thickness."

In another paper, Mr. Janssen deduces some further conclusions of interest. He observes:—

"If the solar layer which forms the photosphere were in a state of repose and perfect equilibrium, it would result from the fact of its fluidity, that it would form a continuous envelope around the solar nucleus. The granular elements would be confounded together, and the lustre of the sun would be uniform in all its parts. But the ascending gaseous currents do not admit of this state of perfect equilibrium. They break up and divide the fluid layer, escaping at a great number of points. Hence results the formation of the granular elements, which are but so many fractions of the photospheric envelope, and which tend to take a spherical form, in virtue of the gravity of their constituent parts. . . . But even this state of equilibrium of the individual parts is but rarely realised; in numerous points, the currents drag along with them the granular elements, and these latter lose their spherical form, and eventually become no longer recognisable where the movements are most violent. . . . Moreover, in the regions of relative calm, the movements of the photospheric medium do not allow the granular elements to arrange themselves in an even layer, whence results the greater or less immersion of the grains beneath the surface, and consequently, owing to the great absorptive action of the medium, the great differences of their lustre shown in the photographic pictures. . . . We may further conclude, from the fact of the relative rarity of the most luminous grains in the photographs, that the illuminating power of the sun is due principally to that of a small number of points on his surface. In other words, if the solar surface were completely covered with granular elements of equal brilliancy with these, its illuminating power, according to a first approximate estimate, would be from ten to twenty times greater than it is." It will be interesting to ascertain, at the next epoch of sun-spot maximum, whether the brilliant granules occupy a relatively larger proportion of the solar disc than at the present time. The direct evidence which such an observation will afford on the important question of the periodic variation of solar radiative intensity, a question on which much diversity of opinion still exists, will be of the highest value.

H. F. BLANFORD

BIOLOGICAL NOTES

THE ANATOMY AND AFFINITIES OF THE AYE-AYE.—Dr. Alix having recently dissected a young male Aye-aye (*Chiromys Madagascariensis*), communicates, through Prof. Gervais, to the Academy of Sciences of Paris (*Comptes Rendus*, July 29, p. 219), some notes on certain points in its anatomy which bear upon the much-vexed question of the position of this curious animal in the mammalian series. It seems that his observations confirm in all points the opinion of all those eminent naturalists who, in accordance with De Blainville, and contrary to Gmelin and Cuvier, have held that the Aye-aye must be approximated to the lemurs and separated from the rodents, fresh facts being brought forward in support of this view. First, as regards its myology. The extensor communis hallucis, which in rodents is attached to the outer condyle of the femur, arises in the Aye-aye from the tibia. The biceps brachialis, which has only one head in the majority of rodents, has two in the Aye-aye. The supinator longus, which is generally absent in the rodents, has in the Aye-aye a good development. The common extensor of the digits, to those of the hand or foot, is composed of two distinct fascicles, of which one furnishes the tendons of the second and third digits, the other those of the fourth and fifth, from which it results that the Aye-aye, like the other Lemurina, possesses a paired digital system, and resembles in this feature the cloven-hoofed Pachyderms and the Ruminants, while the other mammals have, under all relations, an unpaired digital system. Dr. Alix has, moreover, verified the presence of a rotator muscle of the fibula, previously men-

tioned by Dr. Murie and Mr. Mivart in their paper upon the anatomy of the Aye-aye, published in the *Proceedings* of the Zoological Society. In examining the nervous system of the cervical region arrangements were discovered quite different from those seen in rodents. For example, the trunk of the great sympathetic nerve, which is otherwise separated from the pneumogastric in the whole extent of this region, has no middle cervical ganglion, but only an inferior one, excessively reduced in bulk. The superior cervical ganglion, situated immediately above the bifurcation of the common carotid, adheres by its fibrous sheath to the pneumogastric; and it is at this spot that the superior laryngeal nerve detaches itself from the pneumogastric, crossing the ganglion with which it enters into connection. On the left side there is no indication of a nervous filament answering to a depressor nerve, while on the right there may be seen to detach themselves from the superior laryngeal nerve two filaments of excessive tenuity which go to rejoin the trunk of the great sympathetic nerve. Nothing in this arrangement suggests resemblance to the nervous cord so distinct among the rodents, and above all among the Leporidæ, which, from this very circumstance, have furnished physiologists with the opportunity of making experiments of the greatest value. This character distinguishes the Aye-aye also from the opossums, which were placed by Illiger with the apes and lemurs in his order "Pollicata." The nervous arrangements, in short, confirm the results arrived at by the study of the muscles, viscera, and organs of generation, of the external form, skeleton, and dentition. J. C. G.

PROF. CARUEL'S CLASSIFICATION OF THE VEGETABLE KINGDOM.—At the close of his recent work, "La Morfologia Vegetale," Prof. Caruel of Pisa proposes a classification of the vegetable kingdom which has not so much of novelty in its principles of classification as in its terminology and the salient characters of the groups. He makes the following five primary groups, viz. :—1. PHANEROGAMIA. Every individual is trimorphic. The first form is neutral, and is capable of indefinite development, and of organic reproduction, principally by means of buds. This organic form gives rise, through the medium of the flower, to the two other (sexual) forms, male and female, which have only a definite development. The male form or pollen is thalloid; the female form or gemmule (ovule) is cormoid; this last produces, first, a pro-embryo as the result of the fecundation by the fovilla of the pollen, of an oosphere contained in a closed oogonium, and finally, the embryo of the neutral form, which develops at the extremity of the pro-embryo and in the same direction. In the subdivision of Phanerogamia, Caruel discards the distinction between Gymnospermia and Angiospermia, retaining, as the two primary classes, Monocotyledones and Dicotyledones, and giving the higher rank to the former. 2. SCHISTOGAMIA, including Characeæ only. These are also trimorphic; but the male sexual form consists of vermiform phytozoa (antherozoids) instead of pollen-grains, formed in an antherocyst (antheridium) differing in structure from the anther; the female form consists of an oogemma (archegonium) comparable to a gemmule, but naked; the neutral form springs directly from the oospore, which, on germinating, produces the embryo transversely. 3. PROTHALLOGAMIA, or Vascular Cryptogams. These are also trimorphic The neutral form does not produce the two sexual forms, but spores; these, on germinating, are transformed into sexual prothallia, with archegonia and naked oospheres, and vermiform phytozoa contained in antheridia; the oospore gives rise transversely to the embryo of the neutral form. The Prothallogamia are divided into Heterosporæ and Isosporæ. 4. BRYOGAMIA (synonymous with Muscineæ). The distinguishing character of this group is the indefinite power of development of the female individual, together with the definite development of the neutral form or sporogonium. A consequence of this is the continued and repeated fecundation of which the female form is capable, which distinguishes the Bryogamia from the three preceding groups. The embryo springs directly from the oospore; the male forms are phytozoa. The group is divided into Musci and Hepaticæ. 5. GYMNOGAMIA (Thallophyta or Cellular Cryptogams). The simplest Gymnogamia possess only a single form, which is reproduced agamically by fission, by conidia and sporidia, or by gamogenesis, but without any sexual differentiation. In others there is sexual differentiation into male and female forms; a few have also a third neutral form, when the oospore produces zoospores, instead of passing directly into the female form. They resemble the Bryogamia in the definite development of the neutral form and the indefinite development of the female form, but differ in the zoospore-like form of the phytozoa, and in the structure of the oogonium, which is isolated and naked, and does not form part of an archegonium. Prof. Caruel altogether discards the old classification of Thallophytes into Algæ, Fungi, and Lichens, but does not propose any other in its place, thinking it probable that, as our knowledge of some of its forms increases, it will be broken up into several primary groups He thinks it would be an advantage if the term Cryptogamia were altogether disused.

TRANSITION FORMS OF CRINOIDS IN AMERICAN PALÆOZOIC ROCKS.—Messrs. C. Wachsmuth and F. Springer have carefully studied the crinoids of the subcarboniferous rocks of the Mississippi valley, especially the Burlington and Keokuk limestones. There is probably no region in the world which exhibits, within the same limited geographical extent, so great and uninterrupted a range of crinoidal deposits in geological succession, almost unaltered. These observers conclude that extravagant forms and developments are not perpetuated, and that types mostly cease to exist when they reach a culmination in anatomical features. A large proportion of the genera become extinct in the formations above mentioned. The extinction of specific forms was not coincident with the close of the respective epochs of limestone deposits, but most of the changes were made by a series of slow and gradual modifications of specific characters, which correspond in a striking manner with the changes in individual life by growth. The smaller and less conspicuous forms were generally persistent, and ranged through the whole crinoidal formations with comparatively little change.

GEOGRAPHICAL NOTES

ACCORDING to present arrangements, we believe that Mr. Keith Johnston, the leader of the expedition which the Committee of the African Exploration Fund are about to despatch from the East Coast of Africa to Lake Nyassa, will leave England on November 14 for Zanzibar, together with his second in command, Mr. Thomson, whose more especial function it will be to study the geology of the country traversed. Mr. Thomson, we believe, has had an excellent training as a geologist, and it is expected that he will make important contributions to our knowledge of the geology of the region to be visited. The expedition will not actually start for the interior till next spring, and the interval will no doubt be utilised in making short journeys on the mainland, and in procuring all information possible in regard to the inhabitants, language, &c., of the region which is about to be thoroughly and scientifically explored. We sincerely trust that Mr. Johnston may not meet with the same trouble in the matter of porters as has so long retarded the progress of the Belgian and one or two other expeditions, but we do not hear that the Royal Geographical Society have formally given in their adhesion to the most recent